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The Effect of a Shift in Time of Deprivation Upon Performance in Instrumental Learning

By CHARLES K. RAMOND

Behavior has often been found to be a positive function of the strength of the hunger drive (D), where the latter was defined in terms of hours of food deprivation (Td). Attempts to interpret this relationship have been concerned with two alternatives: either Td determines only D, or Td determines, in addition to D, the amount of learning or habit strength (H) acquired.

Characteristic experimental designs have been used to evaluate these alternative explanations. In one set of experiments (2, 4, 5, 8, 11, 12), after an initial period of constant drive, responses are observed in a test period during which drive is varied. Performance differences in this test period presumably reflect differences only in D, since all conditions under which the habit was acquired were constant. Thus the observed relationship between test-period response strength and Td has been taken to indicate the relation of D to Td.

In a second type of experiment, drive is varied during training and later held constant in a test period. Performance differences in this second period have been interpreted as the result of differential habit strength acquired in training, since drive is held constant on test trials. Thus in this case, the observed relationship between test-period response strength and Td has been thought of as equivalent to the relation between habit strength (H) and Td. Results obtained in this second type of design, however, have not been conclusive. Finan (1) obtained performance differences in the test period, which suggested that habit strength was a function of Td. Subsequent studies by Kendler (3) and Strassburger (13), on the other hand, found no such differences.

A third type of experiment which bears on these alternatives varies time of deprivation during both the initial acquisition period and the later test period. Two groups of subjects are trained at different drive levels, following which a random half of each of these groups is shifted to the drive level of the other group. Measures of test period (post-shift) response strength for the four resulting drive groups are then considered in the following manner:

		Test Period Drive Strength	
		High	Low
Drive strength During Training	High		
	Low		

Results in the above design are interpreted as follows: a significant difference between column means indicates that response strength is a function of then-present time of deprivation, i.e., R = f(Td). A significant difference between row means indicates that post-shift response strength is a function of the Td under which training was given. As was stated above, this result is taken to mean that time of deprivation has contributed to some lasting condition of the organism (habit strength), or, in other words, that H = f(Td).

Loess (6), using such a factorial design, found no significant effect of training period Td, hence no evidence for H as a function of Td. This result, like those of Kendler and Strassburger, disagreed with Finan's findings, therefore additional experimental comparisons of the alternative hypotheses seemed advisable. The present paper will report two such comparisons which were obtained as a portion of a recent experiment (9), and some related findings from a second experiment (10).

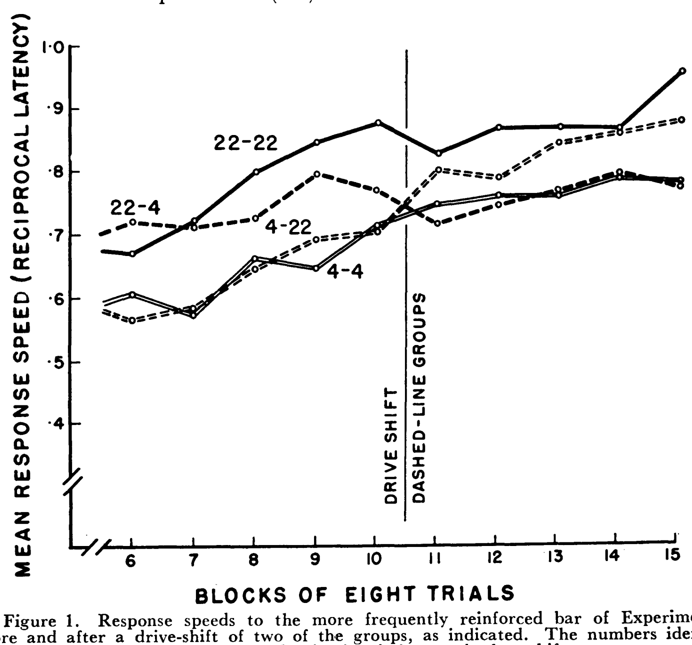

Figure 1. Response speeds to the more frequently reinforced bar of Experiment 1 before and after a drive-shift of two of the groups, as indicated. The numbers identifying the curves stand for hours of deprivation before and after shift.

Method

The apparatus used has been described in detail elsewhere (6, 7). Essentially, it consisted of a modified Skinner box in which either or both of two bars could be presented. The data reported below refer only to those situations in which a single bar was present. The response measured was the subject's speed in traversing the box, operationally definable as the reciprocal of the time elapsing between the opening of the starting box door and the subject's contact with the bar. All trials were reinforced by automatic presentation of an .08-gram pellet of Purina Laboratory Chow at a specific interval after bar-contact.

The subjects used were 88 hooded rats from the colony of the Iowa Psychological Laboratory, and were 90-135 days old at the beginning of the experiment. Forty-eight of these rats were in the first experiment, and provided the data for the first two comparisons given below. The other 40 rats, in a second study, furnished the latter data.

After ten days of habituation to an eight-gram per day feeding schedule, acquisition trials began. In the first experiment, which used 48 rats, half were always run 22 hrs. after feeding time, and the other half after 4 hrs. After 80 trials to one bar, and 40 concurrently administered trials to the other bar, the drive levels of a random half of each of these groups was shifted to that of the other group by means of changing the time of day training was given. In the second experiment, as in the first, half the rats were run under 22 hr. drive and the other half under 4 hr. drive. The drive levels of *all* animals in this experiment, however, were shifted after 104 trials to a single bar. Furthermore, each drive group in this second study was divided into sub-groups on the basis of another variable, delay of reinforcement. Half of each drive group received pellets 1 sec. after bar-contact, while the other half were reinforced 5 sec. after bar-contact.

Results

The results of the first experiment are presented in Figs. 1 and 2. The first graph shows the response speeds of the four drive groups following 80 trials to one bar, while the second graph pictures the corresponding response speeds of the same animals after 40 concurrently administered trials to the other bar. The group mean response speeds during the last 40 trials of the post-shift period are shown in Table 1.

Table 1

Mean Post-Shift Response Speeds, Last Forty Trials, Experiment 1.

More Frequently Reinforced Bar				Less Frequently Reinforced Bar			
Training Period D	Test Period D 22 hr.	Test Period D 4 hr.	Row Means	Training Period D	Test Period D 22 hr.	Test Period D 4 hr.	Row Means
22 hr.	.917	.784	.850	22 hr.	.729	.666	.698
4 hr.	.870	.772	.821	4 hr.	.743	.559	.651
Col. Means	.894	.778		Col. Means	.736	.613	

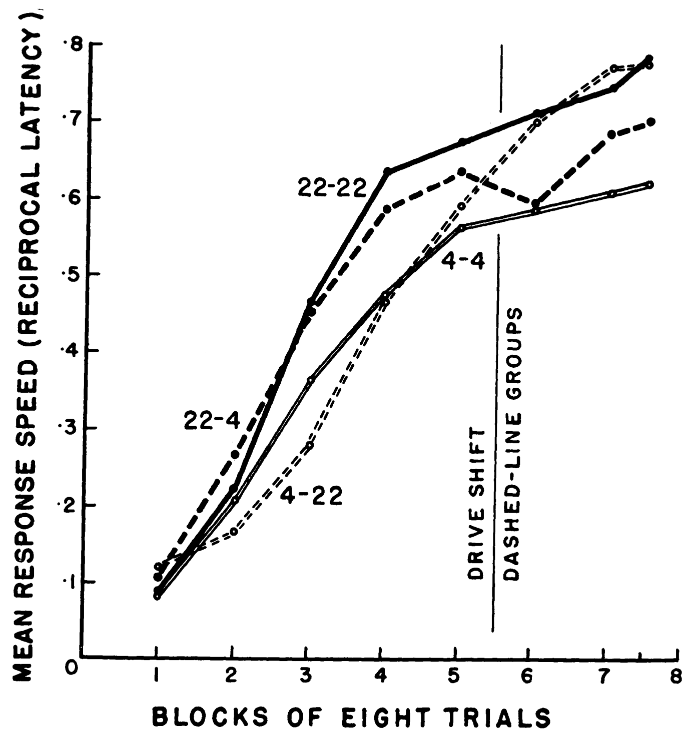

Figure 2. Response speeds to the less frequently reinforced bar of Experiment 1 before and after a drive-shift of two of the groups, as indicated. The numbers identifying the curves stand for hours of deprivation before and after shift.

An analysis of variance of the above differences in a single mixed design yielded the following F-ratios (df = 1, 44): (a) main effect of training period drive, F = less than 1; (b) main effect of test period drive, F = 10.87 (p = .01). No interactions were significant beyond the .1 level.

The above findings show that training period drive has no significant effect upon test period performance after training periods of either 40 or 80 trials. Hence we may infer, according to the above discussion, that drive makes no contribution to the learning factor, but merely affects current performance level. More specifically, we may conclude, with Kendler, Strassburger and Loess, that habit strength is not a function of time of food deprivation.

One interesting aspect of the preceding results was that the group whose drive level was shifted downward (22 hr. to 4 hr.) displayed some tendency to run more slowly just after the drive shift, as would be predicted, but then to run somewhat faster. An explanation which suggested itself was that this group had not yet reached an asymptotic level of performance at the time of drive shift. In other

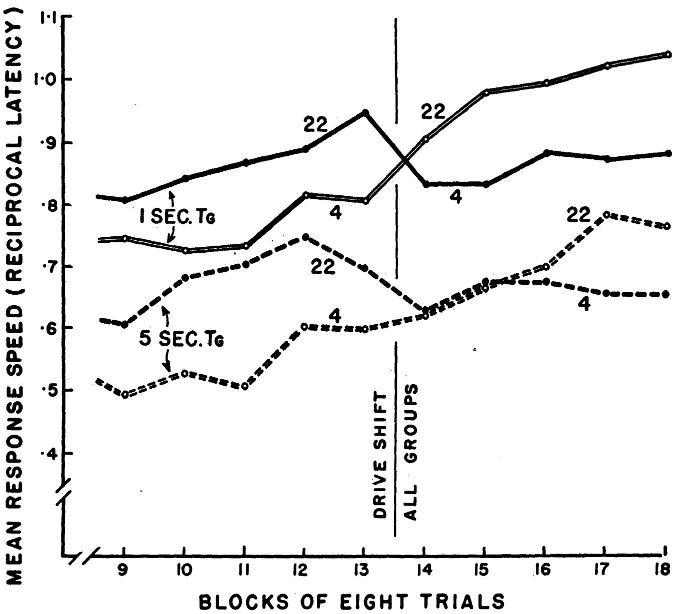

Figure 3. Response speeds to a single bar in Experiment 2, before and after a drive shift of all groups. Tg stands for delay of reinforcement. The numbers indicate hours of deprivation during the period.

words, the post-shift increment may have been a reflection of the continuing growth of habit strength. If this were so, then the longer the pre-shift training period, the less should be this tendency for the downward-shifted group to return to a higher level of performance.

The results of the second experiment tend to confirm this expectation. Fig. 3 shows the post-shift performance of groups given 104 pre-shift trials, i.e., 24 more such training trials than were given in the first experiment. These downward shifted groups appeared to remain at their lower asymptote reached after drive-shift. One possible conclusion to be drawn from this finding is that results obtained following a shift of a motivational variable will be more stable to the degree that pre-shift asymptotic performance has been attained.

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